Record of Decision
Remedial Alternative Selection

Site Name and Location

Sullivan's Ledge
New Bedford, Massachusetts

Statement of Purpose

This Decision Document presents the selected remedial action for this site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP); 40 CFR Part 300 et seq., 47 Federal Register 31180 (July 16, 1982), as amended.

The Commonwealth of Massachusetts has concurred with the selected remedy.

Statement of Basis

This decision is based on the administrative record which was developed in accordance with Section 113(k) of CERCLA and which is available for public review at the information repositories located in the New Bedford Free Public Library, New Bedford, Massachusetts, and at 90 Canal Street, Boston, Massachusetts. The attached index identifies the items which comprise the administrative record upon which the selection of a remedial action is based.

Description of the Selected Remedy

The selected remedial action for the Sullivan's Ledge site consists of source control and management of migration components but excludes action on Middle Marsh which will be addressed as a separate operable unit.

The source control remedial measures include:

- Excavation and solidification of approximately 24,000 cubic yards of contaminated on-site and off-site unsaturated soils. The solidified soils will be placed on-site, above the existing ground surface;

- Excavation, dewatering and solidification of approximately 1,900 cubic yards of contaminated sediments from the unnamed stream and the first and second golf course water hazards. Solidified sediments will be

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disposed on-site, above the existing ground surface; and

° Construction of an impermeable cap over a projected 11 - acre area extending over a major portion of the total surface area of the disposal site. Based on the conceptual design, the cap will consist of four layers: clay, buffer, drainage, vegetative.

The management of migration measures include:

- ° Temporary diversion and lining of the portion of the unnamed stream parallel to the eastern boundary of the site;
- ° Active groundwater collection system composed of deep bedrock extraction wells located in close proximity to the disposal pits;
- ° Passive underdrain collection system located at the top of the bedrock surface along the eastern and northern boundaries of the disposal site; and
- ° Groundwater treatment consisting of oxidation/filtration for metals removal and ultraviolet/ozonation for organics removal

Additional measures include:

- ° Wetland restoration/enhancement of wetland areas adversely impacted by remedial action and ancillary activities;
- ° Long term environmental monitoring of on-site and off-site overburden and bedrock groundwater and sediments in the unnamed stream; and
- ° Institutional controls designed: (i) to ensure that groundwater in the zone of contamination will not be used as a drinking water source; and (ii) to ensure that any use of the site will not interfere with the effectiveness of the cap

The estimated present worth cost for the selected remedy, including both source control and management of migration components is $10,100,000. This estimate includes capital costs as well as construction and operation and maintenance costs.

Declaration

The selected remedy is protective of human health and the environment. The remedy satisfies the statutory preference for treatment that permanently and significantly reduces the volume, toxicity and mobility of the hazardous substances, pollutants and contaminants as a principal element. The selected remedy also utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and is cost-effective. Except for the attainment of Safe Drinking Water Act Maximum Contaminant Levels (MCLs), Massachusetts Drinking Water Standards and Massachusetts Groundwater Quality Standards, the selected remedy attains federal and state requirements that are applicable or relevant and appropriate (ARARs).

Finding under Section 121(d)(4)(c)

As discussed in more detail in the summary document to this Record of Decision, the attainment of MCL ARARs in the on-site and immediately off-site groundwater has been found to be technically impracticable. The determination of technical impracticability is based primarily on the nature of the wastes and contaminants within the pits and along the bedrock fractures, and the geology of the site. Specifically, the bedrock fractures are irregular both in length and orientation and as such cannot be accurately located, especially at depths greater than 100 feet. In addition, the pockets of highly contaminated wastes located within the pits and along fractures cannot be cleaned up by conventional excavation and pumping methods as it is technically not possible to locate and extract all the contaminated pockets. For further discussion, please see Chapters 4, 5 and 7 of the Phase I Remedial Investigation (Ebasco, 1987), Chapters 4 and 5 of the Phases II Remedial Investigation (Ebasco, 1989) and Chapter 11 of the Feasibility Study (Ebasco, 1989) and Sections X.B.3 and XI.B. of the summary document to this Record of Decision.

June 29, 1989
Date

Paul G. Keough, Acting
Michael R. Deland
Regional Administrator, EPA Region I

ROD DECISION SUMMARY

SULLIVAN'S LEDGE SUPERFUND SITE

NEW BEDFORD, MASSACHUSETTS

JUNE 28, 1989

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION I

Sullivan's Ledge Site

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ROD DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

SITE NAME: Sullivan's Ledge
SITE LOCATION: New Bedford, Massachusetts
SITE DESCRIPTION: Sullivan's Ledge, a 12-acre disposal area, is located on Hathaway Road in an urban area of the City of New Bedford, Bristol County, in Southeastern Massachusetts. The disposal area is roughly bounded on the north by Hathaway Road, on the south by I-State 195/Route 140 Interchange and on the east and west by commercial development (see Figure 1). Immediately north of Hathaway Road is the Whaling City Country Club, which covers about 250 acres. Throughout this Record of Decision (ROD) the disposal area is referred to as Sullivan's Ledge (SL) or the Site.

The study area includes the Sullivan's Ledge disposal area and the country club because contamination migrates from the site via an unnamed stream to the country club, and contaminated groundwater also discharges from seeps along Hathaway Road. Surface water bodies in the study area include the unnamed stream, golf course water hazards, Middle Marsh and the Apponagansett Swamp. The unnamed stream follows a well-defined channel starting adjacent to the eastern border of the site, continuing northward across the golf course, bisecting Middle Marsh and eventually draining into the golf course water hazards. Surface runoff, overburden groundwater and shallow bedrock groundwater from the disposal area discharge to the unnamed stream. Estimates of flood potential presented by the unnamed stream were presented in the Phase I RI. The 100-year floodplain for the site is delineated in Figure 2. This figure shows that only a small portion of the disposal area, at the northeastern corner, lies within the 100 year floodplain.

The 12-acre Sullivan's Ledge disposal area is a former granite quarry. Four granite quarry pits with estimated depths up to 150 feet have been identified from historical literature and field investigations. After quarrying operations ceased, the land was acquired by the City of New Bedford. Between the 1930's and the 1970's the quarry pits and adjacent areas were used for disposal of hazardous materials and other industrial waste.

A more complete description of the site can be found in the "Phase I Remedial Investigation Report; June 1987" in Chapter 1 of Volume I.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

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A. Response History

The United States Environmental Protection Agency (EPA) conducted an air monitoring program of the Greater New Bedford Area in 1982 and installed groundwater monitoring wells around the Sullivan's Ledge site in 1983. Based, in part, on the results of these studies, the site was included on the National Priorities list in September 1984. The Phase I and Phase II Remedial Investigations, performed by EPA, were completed in September 1987 and January 1989, respectively. The Feasibility Study was also completed in January 1989.

In September 1984, EPA issued the owner of the site, the City of New Bedford, an Administrative Order under Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). In compliance with this Order, the City of New Bedford in 1984 secured the disposal area by installing a perimeter fence and posted signs warning against unauthorized trespassing of the site.

A more detailed description of the site history can be found in the "Phase I Remedial Investigation Report; June 1987" in Chapter 1 of Volume I.

B. Enforcement History

In September 1984 an Administrative Order was issued to the City of New Bedford to conduct the activities as outlined in the preceding Response History section.

On November 29, 1988, EPA notified approximately 15 parties who either owned or operated the facility, generated wastes that were shipped to the facility, or transported wastes to the facility, of their potential liability with respect to the Site.

The PRPs have been active in the remedy selection process for this site. Technical comments presented by the PRPs during the public comment period were summarized in writing, and the summary and written responses were included in the Responsiveness Summary in Appendix A.

Special notice has not been issued in this case to date.

III. COMMUNITY RELATIONS

The Sullivan's Ledge site was originally included as part of the New Bedford Harbor site, known as the Greater New Bedford Superfund site. The level of community concern about the Greater New Bedford site was quite high during the fall of 1984, when an open house was held by EPA to explain cleanup options for PCB "hot spots," and a public hearing was held to obtain comments from citizens and local agencies and organizations. About that same time, the EPA and the Massachusetts Department of Public Health announced the start of a three-year health study in the greater New Bedford area that included testing individuals to determine the level of PCBs in their bloodstream. EPA provided funding for the study.

Other public meetings held to discuss findings or information about the New Bedford sites occurred in January and October of 1985. At the October 1985 meeting, the EPA announced the decision to separate the Sullivan's Ledge site from the Greater New Bedford Superfund site and include the Sullivan's Ledge site on the National Priorities List (NPL). The decision to create a separate site was based on the following considerations:

1. The severity of the problem and the environmental complexity of the Sullivan's Ledge site.

2. Environmental diversity between harbor areas (aquatic) and the Sullivan's Ledge site (primarily wetlands and uplands).

3. Difference in the range of contaminants found.

4. Possible differences in potentially responsible parties (PRPs) at the sites.

5. Degree to which separate management would facilitate activities at the sites.

Throughout the site's more recent history, community involvement has been moderate. EPA has kept city government officials and other interested parties informed through informational meetings, fact sheets, press releases and public meetings.

In September 1986, EPA finalized a community relations plan which outlined a program to address community concerns and keep citizens informed about and involved in activities during remedial activities. On July 20, 1988, EPA held an informational meeting to present the results of the Remedial Investigation and to answer questions from the public.

An administrative record was prepared and made available to the public on February 6, 1989. On that same date, EPA held an informational meeting to discuss the cleanup alternatives presented in the Feasibility Study and to present the Agency's Proposed Plan. From February 6 to March 27, 1989, the Agency held a forty-nine day public comment period to accept public comment on the alternatives presented in the Feasibility Study and the Proposed Plan and on other documents available to the public. On February 21, 1989, the Agency held a public hearing to accept oral comments. A transcript of this hearing and the comments and the Agency's response to comments are included in the attached responsiveness summary.

IV. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The selected remedy was developed by combining components of different source control alternatives and a management of migration alternative to obtain a comprehensive approach for site remediation of all portions of the site except for Middle Marsh. In summary, the remedy consists of nine components:

1. Site preparation;
2. Excavation, solidification and on-site disposal of contaminated soils;
3. Excavation, dewatering, solidification and on-site disposal of contaminated sediments;
4. Construction of an impermeable cap over an 11-acre area;
5. Diversion and lining of a portion of the unnamed stream;
6. Collection and treatment of contaminated groundwater;
7. Wetlands restoration/enhancement;
8. Long-term environmental monitoring; and
9. Institutional controls, including restrictions on groundwater use.

The U.S. Department of Interior (DOI) and the Massachusetts Department of Environmental Quality Engineering (MA DEQE) have raised concerns that, if the PCB-contaminated sediments in Middle Marsh are not excavated, they may continue to pose a long-term threat to a variety of aquatic and terrestrial organisms that inhabit the Middle Marsh area. In view of these concerns, EPA has determined that additional studies including biological studies are needed before a final remedial action decision on Middle Marsh is given. Therefore, this Record of Decision will not incorporate a remedial action decision on Middle Marsh. Instead, this portion of the study area will be studied as a separate operable unit and the decision on the appropriate remedial action for Middle Marsh will be made in a separate ROD.

V. SITE CHARACTERISTICS

The significant findings of the Remedial Investigation are summarized below:

A. General

Field Investigations were conducted in 1986 and 1988. The results of the investigations revealed high concentrations of polychlorinated biphenyls (PCBs) in surface soil, subsurface soils and sediments. In addition, the results indicated the presence of volatile organic compounds (VOCs) and inorganics in groundwater sampled from a network of wells both on- and off-site.[1]

Based on the results of the two RIs, EPA has concluded that the sources of contamination at the Sullivan's Ledge site are on-site soils, PCB-contaminated sediments that have washed off of the 12-acre site into the unnamed stream and wetland areas, and wastes disposed of in the former quarry pits. EPA has further determined that surface water and overburden and bedrock groundwater both on- and off-site are significantly contaminated from wastes contained within the pits.

Surface water and groundwater represent the major migration pathways for volatile organic contaminants. Erosion of soils from the site into the unnamed stream is the most significant pathway for movement of PCBs and PAHs. Airborne transport is of little consequence at the site.

In general, a marked pattern of decreasing contamination (both in terms of numbers of contaminants and their respective concentrations) is evident with increasing distance from the site. The pattern is typified, with few exceptions, by the drop in concentrations of volatile organics in both groundwater and surface waters north of the site. Surface soil contamination exhibits a similar pattern with respect to contaminants found in this medium. Sediments, however, exhibit a comparatively undiminished loading of PCBs throughout the golf course area. This is apparently a function of the manner in which PCBs are distributed in the environment; primarily as adsorbed materials to soils, so that their distribution mirrors that of sediment deposition along and from the stream.

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[1]Except where otherwise noted, "on-site" is used throughout this ROD to describe the 12-acre disposal area and "off-site" refers to areas outside the 12-acre disposal area.

B. Hydrogeology

Hydrogeologic investigations were conducted as part of the Phase I and Phase II RIs to characterize groundwater flow and contaminant transport. Based on the geological and geophysical evidence presented in the reports, the following conclusions are made:

1. The shallow bedrock is highly fractured and the fracture planes vary both in frequency and orientation. This means that the shallow bedrock exhibits the properties of a porous medium, with groundwater flowing in the direction of the hydraulic gradient. Contaminant migration in the shallow bedrock groundwater would be expected to follow the shallow groundwater flow paths and form contaminant plumes.

2. The deep bedrock contains fewer fractures than the shallow bedrock; these discrete fracture planes follow a regional north/northwest lineament trend. Contaminant migration in these deeper fractures is controlled by the orientation of these fractures. The potential exists for contamination to migrate relatively long distances along these specific fractures. However, given the significant depths (>200 feet) and unpredictability of the fracture orientations, the exact locations of all deep bedrock fractures are technically infeasible to determine. Furthermore, the possibility of locating all pockets of contamination within these fractures is highly unlikely.

On a regional scale, groundwater flow in the overburden, shallow bedrock and deep bedrock is to the north. On a local scale, groundwater flow in the overburden and shallow bedrock is influenced by surface features (i.e. the unnamed stream). Flow in the deep bedrock locally is controlled by the distribution and orientation of fractures. Local groundwater flow at the site is from the southwest corner to the northeast corner (see Figure 3). Flow from the southwest corner of the site enters the quarry pits and discharges out of the pits. Part of this flow discharges into the overburden and the unnamed stream. The remainder of the flow discharges into the bedrock. Components of groundwater flow in the bedrock discharges to surface water bodies north of the quarry pits. A more detailed discussion of groundwater flow is presented in Chapter 4 of the Phase II RI.

C. Soil

Most of the Sullivan's Ledge Site is covered by a layer of fill which overlies the bedrock and quarry pits. The thickness of the fill generally increases to the south and east across the property with the maximum observed thickness of 22.4 feet of fill (exclusive of the quarry pit areas) found in the southwest corner of the site. The fill is found throughout the site property, except in the northwest corner of the site where bedrock outcrops were observed, and the southeast corner of the site, where glacial till and swamp deposits were found. Field observations indicated that fill material on the site is largely derived from local glacial deposits (silt, sand, gravel and rock fragments), with rubber tires, wood, scrap metal, and metal objects mixed in.

The RI reports identified areas of soil contamination. Organic contamination at the site was detected at all sampling depths within the unsaturated layer. Soil samples generally contained low total concentrations of volatile organic compounds. Unsaturated site soils are primarily contaminated with polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) and lead. Although contamination has occurred throughout most of the site, the soils along the eastern and southern boundaries contain the highest concentrations of PCBs and PAHs. The highest lead concentration, greater than 10 times the mean value, was detected in unsaturated soils along the southern boundary of the site. Maximum measured soil concentrations of PCBs, PAHs and lead are 2,400 ppm, 88.5 ppm and 4,600 ppm, respectively.

D. Sediments

Soils have eroded from the site into the unnamed stream and have been transported from the site. As a result, the sediments in the unnamed stream, Middle Marsh, four golf course water hazards, and a portion of the Apponagansett Swamp are contaminated with PCBs from the Sullivan's Ledge site. Contaminants detected in sediments include inorganics and organics, primarily PCBs and PAHs.

Significant levels of PCBs in sediments were found within the study area, as described below:

Location	Maximum PCB concentration (mg/kg)
Unnamed stream	90
Middle Marsh	60
Golf course water hazards	18
Apponagansett Swamp (south)	19
Apponagansett Swamp (north)	18

The sediments in the stream also contained maximum concentrations of aluminum and iron of 40,000 mg/kg and 374,000 mg/kg, respectively. Numerous PAHs were also frequently detected in the unnamed stream, with average concentrations less than 1 mg/kg for each compound.

E. Quarry Pits

Based on historical documentation and data from the field investigations, four quarry pits estimated to be as deep as 150 feet have been identified. The quarries are located in fractured bedrock. Based on historical documents, the contents of the pits may include rubber tires, scrap metal, automobiles, transformers, capacitors and miscellaneous rubble. Technical difficulties with drilling in quarries which have been filled with debris and solid waste prevented direct sampling of the contents of the quarries. However, groundwater sampling was conducted immediately adjacent to the quarry pits in order to characterize the liquid contents of the pits.

F. Groundwater

Volatile organic compounds (VOCs) were the predominant groundwater contaminants identified in the Phase I and Phase II RIs. VOCs were identified in overburden groundwater, shallow bedrock groundwater (i.e. less than 100 feet), and deep bedrock groundwater:

1. Overburden groundwater

Volatile organic contaminants detected in groundwater samples from overburden monitoring wells include: benzene, 1,2-dichloroethene, trichloroethene, ethylbenzene, chlorobenzene and vinyl chloride. Total VOCs measured during the RIs ranged from not detected to 8.2 ppm. VOCs in overburden groundwater were greatest in the vicinity of the northernmost quarry pit.

The overburden groundwater contaminant plume is oriented in the same northeastern to northern direction as the projected groundwater flow direction. Figure 4 is a VOC contaminant plume map for the overburden aquifer. As illustrated in the figure, the overburden contaminant plume extends from the site, with the highest contamination around the northernmost pit, to the southern edge of Middle Marsh.

2. Shallow bedrock groundwater

The shallow bedrock plume is similar in configuration and location to the overburden plume. However, VOC contamination in groundwater increases with depth. The VOCs detected in shallow bedrock groundwater were similar to the VOCs detected in the overburden aquifer, but were detected at increased frequency and concentration. The following specific VOCs were detected:

Compound	Range of Detected Concentrations (ug/l)
Benzene	5 - 1200
1,2-Dichloroethene	13 - 51,000
Trichloroethene	5 - 4000
Vinyl chloride	36 - 6900

Total VOCs detected in on-site and off-site monitoring wells during the Phase II RI ranged from not detected, in MW-11, an upgradient well, to 54,000 ug/l in GCA-1 located at the northeast corner of the site.

3. Deep bedrock groundwater

The deep bedrock groundwater system extends from 100 to 300 feet below ground surface. Information gained by the geophysical survey combined with information obtained during the actual borehole drilling indicated that at these depths, bedrock is more uniform with fewer fractures. Contaminant transport at these depths would occur primarily along specific fractures.

During the Phase II RI, four Westbay multilevel sampler wells (ECJ-1,2,3,4) were installed to investigate the deep bedrock system with respect to groundwater flow direction and extent of contamination. With the exception of ECJ-2, each Westbay well was sampled at six different zones.

Average total VOCs in each of the four Westbay wells were detected as follows:

Total VOCs (ppm)

Zone	ECJ-1	ECJ-2	ECJ-3(upgradient)	ECJ-4
1	9.4	21.7	not detected	not detected
2	50.2	30.6	0.02	not detected
3	94.6	38.8	0.01	0.01
4	90.1	23.3	0.01	0.01
5	56.0	27.3	0.01	153
6	9.3		0.02	0.01

It is of particular significance that during one round of sampling of zone 5 of ECJ-4, trichloroethene was detected at an elevated concentration of 270 ppm, at greater than 200 feet below the ground surface and over 1,000 feet from the site. At this concentration, trichloroethene was detected at approximately 25 percent of its solubility, suggesting that dense non-aqueous phase liquids (DNAPLs) may exist in the quarry pits or in on- or off-site deep bedrock fractures.

Contaminants in the deep bedrock were consistent with those found in the overburden and shallow bedrock. Trichloroethene, 1,2 - dichloroethene and vinyl chloride account for 90 percent of the contamination found in the deep bedrock. In general the largest number and concentrations of contaminants were found near the quarry pits. With depth the distribution of contaminants were controlled by their physical properties (i.e. density) and the presence and orientation of fractures. Chapter Five of the Phase II RI presents a more detailed discussion of the distribution of contamination.

G. Surface Water

Surface waters throughout the study area are affected by contaminants associated with the site. Contaminants from the site enter the unnamed stream as dissolved constituents from overland runoff and from groundwater seeps. The following observations support this suggestion:

1. Seeps to the unnamed stream were observed at the south end of the site, along the stream's length and at the northeast end of the site.

2. Surface water was contaminated at the south end of the site with volatile organic compounds.

3. At a seep discharge at the north end of the site, surface water was also contaminated with many of the same chemicals and concentrations as surface waters at the south end of the site.

4. Surface water contaminants detected at the south and north ends of the site were similar to those in groundwater in their respective vicinities.

Table 8-1 of the Phase I RI lists the major surface water organic and inorganic contaminants and their concentrations ranges and provides an indication of their prevalence in surface waters, based on Phase I sampling. As indicated by the table, benzene, chlorobenzene, trichloroethene, trans-1,2-dichloroethene, vinyl chloride, aluminum, barium, copper, iron and lead are the primary surface water contaminants.

Thirteen surface water stations were sampled during the Phase II field investigation. In general, VOCs were detected during this field investigation at decreased frequency and concentration in comparison to Phase I results. VOCs detected in groundwater seeps include trichloroethene, chlorobenzene, benzene, xylenes and 1,2-dichloroethene at maximum concentrations of 9, 43, 45, 68 and 675 ppb, respectively. Of the five surface water stations sampled for semi-volatile organic compounds (SVOCs), two stations contained measurable SVOCs. Station SW-8 (seep location) contained low levels of naphthalene (16 ppb) and n-nitrosodiphenylamine (16 ppb). As in the case of organic contaminants, inorganic contaminant concentrations are significantly higher at seep locations. Seeps SW-6, SW-8 and SW-9 show elevated concentrations of iron. Aluminum contamination was also noted at seeps SW-6 and SW-9. In addition, the Phase II data indicated detectable in-stream concentrations of lead, silver, zinc and barium. Figures 5-8, 5-9 and 5-16 of the Phase II RI depict the surface water and seep sampling results for both inorganics and organics.

H. Biota Investigation

In October 1987, a biological investigation was conducted for the unnamed stream, Middle Marsh, and Apponagansett Swamp, habitats potentially impacted by wastes emanating from the Sullivan's Ledge site. The investigation included aquatic biota sampling at predetermined stations (see Figure 5-17 RI); collection of water quality parameters; and characterization of aquatic and terrestrial habitats. The objective of the investigation was to qualitatively assess general conditions of aquatic ecosystems (stream, marsh, and swamp), such as obvious stress (i.e., absence of certain organisms), presence of indicator species, and indications of pathological stress.

1. Aquatic Habitats

Aquatic habitats located on or associated with the Sullivan's Ledge site include: the unnamed stream (Stations B1 through B7); forested wetlands known as Middle Marsh in the interior of the golf course (Stations B8 through B10); a series of shallow ponds (water hazards) between Middle Marsh and the Conrail line (Station B11); and the Apponagansett Swamp, a forested wetlands north of the golf course (Stations B12 through B16). Aquatic invertebrates collected and species identified at sampling locations in these areas are listed in Table 5-2 (RI).

Three reference stations were established upstream from the groundwater seeps (B1, B2, and B3). At those stations, typically four to five aquatic species were identified per site with 23 to 26 organisms collected. Groundwater seeps are located immediately downstream of Station B3 and immediately upstream of Station B5. Fewer organisms were collected and fewer species were identified at these sites compared to the reference stations. Only two to 12 total organisms were collected, and one to four different species were identified at each station. Thus, Stations B4 through B8 were impacted by the seeps. Stations B12, B14, B15 (Apponagansett Swamp) yielded the highest number of organisms collected and species identified. The organisms (collected from stations B12 to B15) were representative of those typically found in a wetland system. The highest number of organisms found in the Apponagansett Swamp may be attributable to the type of forested wetland which typically supports a more diverse and dense assemblage of aquatic organisms.

2. Terrestrial Habitats

Three types of habitats for terrestrial organisms were identified. These habitats are referred to as old field, forested palustrine wetland, and mowed grassland (see Figure 5-17 RI). Old field communities are those areas that were once cleared and now are in the process of reverting to woodland. Most of the habitats found on-site have been identified as old field communities. Palustrine forested wetlands are the types found off-site in the middle of the golf course and north of the Conrail rail line. Palustrine wetlands are non-tidal wetlands dominated by emergent mosses, lichens, persistent emergents, shrubs, or trees. Mowed grassland areas are the cultivated fairways of the Whaling City Country Club.

A complete discussion of site characteristics can be found in Chapters 4 through 7 of the Phase I RI and Chapters 4 and 5 of the Phase II RI.

VI. Summary of Site Risks

A Risk Assessment (RA) of the site was performed to estimate the probability and magnitude or potential adverse human health and environmental effects from exposure to contaminants found at the site.

Fifty-nine contaminants of concern, listed in Table 1, were selected for evaluation in the RA. These contaminants constitute a representative subset of the more than 80 contaminants identified on-site in the RI. The 59 contaminants were selected based on their relative toxicity, concentration, and mobility and persistence in the environment.

Potential human health risks associated with exposure to the contaminants of concern in surface soils, sediments, air, surface water and groundwater were estimated quantitatively through the development of several hypothetical exposure scenarios. Incremental lifetime carcinogenic risks were estimated and the potential for noncarcinogenic adverse health effects were evaluated for the various exposure scenarios. For carcinogenic compounds, risks are estimated by multiplying the estimated exposure dose by the cancer potency factor of each contaminant. The product of these two values is an estimate of the incremental cancer risk. For noncarcinogenic compounds, a Hazard Index (HI) value was estimated. This value is a ratio between the estimated exposure dose and the reference dose (Rfd) which represents the amount of toxicant that is unlikely to cause adverse health effects. Generally, if the HI is less than one, the predicted exposure dose is not expected to cause harmful human health effects. If the HI exceeds one, the potential to cause noncarcinogenic human health effects increases.

Exposure scenarios were developed to reflect the potential for exposure to hazardous substances based on the characteristic uses and location of the site. A factor of special note that is reflected in the Risk Assessment is that portions of the study area are part of a golf course. Additionally, the Risk Assessment took into account the facts that access to the site is restricted and the land is zoned for commercial development. The Risk Assessment also considered the proposed future use of the site as a soccer field.

Direct contact with surface soil was judged as the most likely exposure route to result in potential health hazards under present site conditions. Although on-site groundwater is not currently used for drinking water, the risks associated with its consumption were evaluated because it is classified as a potential source for drinking water. Inhalation of on-site airborne contaminants was also evaluated quantitatively. Other potential public health and environmental risks associated with direct contact with contaminated surface water and sediments on-site and off-site were also discussed in the RA.

A. Direct Contact with Surface Soil

Human health risks were calculated for an adult assuming occasional site visits and inadvertent contact with contaminated soil. Similar calculations were made for an older child (i.e., 8 to 18 years old) who may play or loiter occasionally on the site. The risks were assessed assuming both mean contaminant concentrations and maximum concentrations. A range of probable absorption rates for different chemicals (i.e., VOCs, SVOCs, PCBs, and inorganics) was used to estimate body dose. Calculated incremental carcinogenic risks were determined to be greater for risks associated with exposure to contaminated soil for a child than for an adult. The incremental lifetime carcinogenic risks for an older child coming in contact with surface soil on-site ranged from $5x10^{-6}$ using site-wide average contaminant concentrations to $5x10^{-5}$ using site-wide maximum contaminant concentrations. PCBs and total PAHs contributed the majority of the total risk.

The Risk Assessment further specified carcinogenic risks to an older child and an adult from exposure to off-site surface soils. For an older child coming in contact with surface soil off-site, incremental lifetime carcinogenic risks ranged from $8x10^{-9}$ to $1x10^{-8}$. In comparison, for an adult coming in contact with surface soil off-site, incremental lifetime carcinogenic risks ranged from $3x10^{-7}$ to $5x10^{-7}$, reflecting the greater frequency of exposure assumed for the adult. PCBs contributed the major portion of the total risk using both average contaminant concentrations and maximum contaminant concentrations.

Noncarcinogenic risk estimates were also specified in the Risk Assessment. Hazard indices (HIs) calculated for exposure to contaminated soil are all less than one with the exception of incidental ingestion of on-site soils by children. A HI greater than one is attributed to only one chemical. This HI of 3.7 is attributed to the maximum concentration of lead detected in an on-site shallow soil sample.

B. Ingestion of Groundwater

Estimated lifetime carcinogenic and noncarcinogenic risks for exposure to groundwater were greatest for ingestion scenarios. Groundwater on-site is not currently used for drinking water, but does represent a potential future source. According to criteria established by EPA Groundwater Protection Strategy guidelines, the aquifer underlying the site is classified as Class IIB aquifer, (i.e., a potential source for future use). Under the Massachusetts DEQE classification system, the aquifer is considered Class I, based on the same potential use. Therefore, the incremental lifetime carcinogenic risk and the noncarcinogenic health risks associated with the ingestion of contaminated groundwater were assessed.

The total incremental carcinogenic risk if a person were to drink the groundwater found under the site for a lifetime containing contaminants of concern at the mean and maximum concentrations, based on the Phase II sampling, was estimated at $1.7x10^{-2}$ and $5.4x10^{-1}$, respectively. Benzene, trichloroethene, vinyl chloride and PCBs contributed over 99 percent of the total cancer risk.

For these same conditions, the total estimated exposure dose exceeds a HI of one. Therefore, there is also an increased potential to cause adverse noncarcinogenic human health effects.

The hazard indices associated with ingestion for a lifetime of groundwater containing contaminants of concern at the mean and maximum concentrations, based on Phase II sampling, were estimated at 63 and 304, respectively. In both cases, 1,2-dichloroethene is the only contaminant with an estimated exposure dose greater than the respective reference dose.

C. Exposure to Sediments

The public health risk assessment performed for the Phase I and Phase II RIs examined risk associated with exposure to contaminated sediments in the unnamed stream and water hazards including direct contact with or incidental ingestion of sediments for a child and for an adult golfer. The highest incremental carcinogenic risk was 1.7×10^{-5}, based on direct contact by an older child with the maximum concentrations of contaminants in the unnamed stream.

The risk assessment also evaluated potential impacts to environmental receptors exposed to contaminated sediments. For the small mammals, rodents and aquatic organisms that inhabit the area, the potential exists for exposure to site associated contaminants through the skin, by ingestion or through the food chain. Of greatest concern is exposure to PCBs because they are difficult to eliminate from the body and may affect the animals and other organisms.

Two approaches were used to evaluate the environmental risk posed by the contaminated sediments.

The first approach was to determine levels of PCBs and total organic carbon (TOC) at various sampling locations, and then to compare those values to the Interim Sediment Quality Criteria (SQC), which vary depending on the TOC value. The sediment quality criteria are numbers which predict the relationship between contaminant levels in sediments and the Ambient Water Quality Criteria (AWQC) which protects wildlife that consume aquatic organisms.[2] There are three levels of SQCs. The upper level represents a 97.5% probability that PCB levels in interstitial water (the water between sediment particles) will exceed AWQCs. The mean level represents a 50% probability of the same event, and the lower level represents a 2.5% probability. Generally, the greater the probability of PCB levels exceeding AWQCs, the greater the risk to wildlife that consume aquatic

[2]For PCBs, the ambient water quality criterion for the protection of aquatic life to allow safe consumption of aquatic organisms by wildlife is 0.014 ug/l.

organisms.[3]

At Sullivan's Ledge, PCBs in sediments exceeded the mean SQC value of 20 ugPCBs/gTOC in all portions of the unnamed stream and in most portions of the water hazards. Furthermore, sediment PCB levels were greater than the upper SQC value in most portions of the unnamed stream and its tributary, and in some portions of the water hazards. In one location, the maximum level was 500 times greater than the upper SQC value.

Based on the comparisons between the SQCs for PCBs and measured PCB levels in sediments, EPA has determined that a potential exists for significant risk to wildlife through consumption of aquatic organisms exposed to PCB-contaminated sediments within the unnamed stream, its tributaries and portions of water hazards 1 and 2.

The second approach was used to assess risks to the aquatic organisms in contact with the PCB-contaminated sediments. The PCB tissue concentrations of these aquatic organisms are projected to be equal to or, in some cases, in excess of those concentrations in the sediment. Assuming a sediment:tissue Bioconcentration Factor (BCF) of 1, the range of PCB tissue concentrations in aquatic organisms are estimated at less than 1.0 to 118 ppm in the unnamed stream and less than 1.0 to 18.0 ppm in the water hazards. PCB tissue concentrations higher than 0.4 ppm in freshwater fish have been associated with reproductive impairment. Therefore, based on assumed tissue levels in aquatic organisms in the unnamed stream and water hazards (1 and 2), aquatic organisms in these areas may be at risk of reproductive impairment or other adverse effects.

The results of the biota investigation, as described in Section V.H, further indicate that the contaminants from the site impact the aquatic biota in the unnamed stream. Reduced numbers and species of organisms were observed from below the seep areas to the Middle Marsh area.

Due, in part, to the presence of orange floc attributable to iron precipitates, both the water and sediments within the unnamed stream and water hazards are aesthetically unappealing, in violation of Massachusetts water quality standards.

D. Exposure to Surface Water/Seeps

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[3] The derivation of upper, mean and lower value SQCs are further discussed in Appendix E of the Feasibility Study.

The public health risk assessment, based on the Phase I sampling results, evaluated the potential risks associated with direct contact exposure to surface water. Various surface water exposure scenarios were developed to evaluate the potential carcinogenic risks and noncarcinogenic health effects. Based on these scenarios, exposure to surface water is not expected to cause non-carcinogenic human health effects. The lifetime incremental carcinogenic risks ranged from $5x10^{-13}$ to $4x10^{-7}$. The maximum incremental carcinogenic risk ($4x10^{-7}$) was derived from a child's direct contact exposure to groundwater seeps. Exposure to n-nitrosodiphenylamine accounted for the majority of this risk.

Concentrations of chemicals of concern detected in surface water were compared to their respective ambient water quality criteria (AWQC) to evaluate potential risk to aquatic organisms. The following results were noted:

1. The mean or maximum detected concentrations in surface water of 10 chemicals exceeded their respective freshwater chronic AWQC during the Phase I field investigation (see Table 6-18 RI). Mean concentrations of bis(2-ethylhexyl) phthalate (BEHP) at 8.13 ug/l; mercury at 1.56 ug/l; copper at 10.44 ug/l; silver at 8.9 ug/l; and lead at 26.8 ug/l exceeded chronic criteria of 3.0, 0.012, 6.5, 0.12, and 1.3 ug/l, respectively.

2. Maximum concentrations of two chemicals exceeded chronic criteria while their mean concentrations did not. The maximum detected concentration of nickel of 82.0 ug/l exceeded the criteria of 56.0 ug/l, and the maximum concentration of chlorobenzene of 53 ug/l was in excess of the 50 ug/l criteria level.

3. PCBs and pentachlorophenol were detected in surface waters only once during Phase I sampling. A PCB concentration of 1.7 ug/l (see Table 6-18 RI) at SW-207 exceeded the final residue value criterion of 0.014 ug/l for PCBs in freshwater. The 8 ug/l pentachlorophenol concentration (see Table 6-18 RI) found at SW-301 exceeded the chronic criteria of 3.2 ug/l.

4. During Phase II field investigations, mean concentrations of BEHP, cyanide, lead, and silver at 251, 48.2, 11.0 and 6.38 ug/l, respectively, exceed their respective chronic water quality criteria (see Table 6-18 RI). Maximum detected concentrations of zinc also exceeded its respective criteria.

Based on comparisons between contaminant concentrations detected in surface water and their respective water quality criteria, as described above, a potential risk exists for aquatic organisms due to exposure to contaminants in surface water of the unnamed stream.

Risk to aquatic organisms due to PCB exposure in water cannot be accurately evaluated by comparing detected concentrations of PCBs to the respective water quality criteria. The detection limit for PCBs was 1.0 ug/l (during both investigations), and the criteria concentration is 0.014 ug/l. However, PCB exposure via water for aquatic organisms is likely in the unnamed stream and water hazards because of high levels of PCBs detected in area sediments. Adverse effects to aquatic organisms can occur as a result of exposure to the 1.7 ug/l concentration detected at SD-614 during Phase I. It is of particular concern that PCB concentrations (Aroclor-1254) of 1.2 and 1.5 ug/l are associated with measurable effects to growth, reproduction, survival, and/or metabolic upset in some aquatic organisms.

A complete discussion of site risks can be found in Chapter 8 of the Phase I RI and Chapter 6 of the Phase II RI.

VII. DOCUMENTATION OF SIGNIFICANT CHANGES

EPA adopted a proposed plan (preferred alternative) for remediation of the site in January 1989. Components of the preferred alternative included:

1. Site preparation;
2. Excavation, solidification and on-site disposal of contaminated soils;
3. Excavation, dewatering, solidification and on-site disposal of contaminated sediments from the unnamed stream and golf course water hazards;
4. Construction of an impermeable cap;
5. Diversion and lining of a portion of the unnamed stream;
6. Collection and treatment of groundwater from on-site overburden and shallow bedrock;
7. Wetlands restoration/enhancement;
8. Long-term environmental monitoring; and
9. Institutional controls, including restrictions on groundwater use.

EPA has made two significant changes to the proposed plan. First, the proposed plan outlined the evaluation of wetland remediation options for Middle Marsh. Three remedial action options were described ranging from no action to excavation and treatment of sediments from 9.5 acres of Middle Marsh. Based, in part, on the significant adverse short-term environmental impacts associated with the excavation and disruption of the forested wetlands, the preferred alternative, as described in the proposed plan, included the no action option for Middle Marsh. However, since issuing the proposed plan, EPA has re-evaluated options relating to Middle Marsh and has determined that additional studies are needed. In addition, the U.S. Department of Interior (DOI) and the Massachusetts Department of Environmental Quality Engineering (MA DEQE) have raised concerns that, if a portion of the PCB-contaminated sediments are not excavated, they may continue to pose a long-term threat to a variety of aquatic and terrestrial organisms that inhabit the Middle Marsh area. In view of these concerns, EPA has determined that additional studies, including biological testing, are needed before a final remedial action decision on Middle Marsh is given. Therefore, this Record of Decision will not incorporate a remedial action decision on Middle Marsh. Instead, this portion of the study area will be studied as an operable unit and the decision on the appropriate remedial action for Middle Marsh will be made in a separate ROD.

Because the decision on remedial action in Middle Marsh has not been included in this ROD but will be addressed in a subsequent ROD, EPA has re-evaluated the eight site alternatives to determine to what extent factors relating to Middle Marsh were used to screen site alternatives. EPA has determined that components of the site alternatives associated with Middle Marsh were not the determining factors in screening out site alternatives and in choosing SA-5 as the selected remedy. Therefore, the site alternatives, as described in the proposed plan will not be changed by deleting components relating to Middle Marsh (i.e. cost). However, analysis of site alternatives, as discussed in this ROD, will not focus on components or issues resulting from proposed remedial action in Middle Marsh.

Second, EPA has determined that locations other than the site's disposal area may require remediation due to soil contamination. Therefore, a sampling program will be implemented to determine the extent of soil contamination in the unsaturated layer in off-site areas immediately north of Hathaway Road and east of the existing fence along the eastern boundary of the site. EPA has estimated that the additional volume of soils that will be excavated from these areas will be minor in comparison to the total 24,000 cubic yards estimated in the Feasibility Study. Therefore, costs associated with the excavation, disposal and/or treatment of soils from outside the site's disposal area are projected to be minimal in comparison to the total estimated cost of the remedy. In the unlikely event that projected costs are substantially greater than expected, the public will be notified and the ROD will be amended.

VIII. DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

Prior to the passage of the Superfund Amendments and Reauthorization Act of 1986 (SARA), actions taken in response to releases of hazardous substances were conducted in accordance with CERCLA as enacted in 1980 and the revised National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, dated November 20, 1985. Until the NCP is revised to reflect SARA, the procedures and standards for responding to releases of hazardous substances, pollutants and contaminants shall be in accordance with Section 121 of CERCLA and to the maximum extent practicable, the current NCP.

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is granted; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a statutory preference for remedies that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes over remedies that do not achieve such results through treatment. Response alternatives were developed to be consistent with these Congressional mandates.

A number of potential exposure pathways were analyzed for risk and threats to public health and the environment in the SL Risk Assessment. Guidelines in the Superfund Public Health Evaluation Manual (EPA, 1986) regarding development of design goals and risk analyses for remedial alternatives were used to assist EPA in the development of response actions. As a result of these assessments, remedial response objectives were developed to mitigate existing and future threats to public health and the environment. These response objectives are:

1. Prevent or mitigate the continued release of hazardous substances to the unnamed stream, Middle Marsh, and Apponagansett Swamp;
2. Reduce risks to human health associated with direct contact with and incidental ingestion of contaminants in the surface and subsurface soils;
3. Reduce risks to animal and aquatic life associated with the contaminated surface soils and sediments;

4. Reduce the volume, toxicity, or mobility of the

hazardous contaminants;
5. Maintain air quality at protective levels for on-site workers and nearby residents during site remediation;
6. Reduce further migration of groundwater contamination from the quarry pits in the upper 150 feet of the bedrock groundwater flow system;
7. Significantly reduce the mass of contaminants in groundwater located in and immediately adjacent to the quarry pits;
8. Provide flushing of groundwater through the pits to encourage continued removal of contaminants at the site; and
9. Minimize the threat posed to the environment from contaminant migration in the groundwater and surface water.

B. Technology and Alternative Development and Screening

CERCLA, the NCP, and EPA guidance documents including, "Guidance on Feasibility Studies Under CERCLA" dated March 1988, and the "Interim Guidance on Superfund Selection of Remedy" [EPA Office of Solid Waste and Emergency Response (OSWER)], Directive No. 9355.0-19 (December 24, 1986) set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements and guidance documents, a range of alternatives were developed for the site involving treatment that would reduce the mobility, toxicity, or volume of the hazardous substances as their principal element. In addition to the range of treatment alternatives, a containment option involving little or no treatment and a no-action alternative were developed in accordance with Section 121 of CERCLA.

Section 121(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. In addition to these factors and the other statutory directives of Section 121, the evaluation and selection process was guided by the EPA document "Additional Interim Guidance for FY '87 Records of Decision" dated July 24, 1987. This document provides direction on the consideration of SARA cleanup standards and sets forth nine factors that EPA should consider in its evaluation and selection of remedial actions.

The nine factors are:

1. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

2. Long-term Effectiveness and Permanence.

3. Reduction of Toxicity, Mobility or Volume.

4. Short-term Effectiveness.

5. Implementability.

6. Community Acceptance.

7. State Acceptance.

8. Cost.

9. Overall Protection of Human Health and the Environment.

Chapter 8 of the Feasibility Study identified, assessed and screened technologies based on engineering feasibility, implementability, effectiveness, and the nature and extent of wastes produced by such technologies. These technologies were combined into source control (SC) and management of migration (MM) alternatives. Chapter 9 in the Feasibility Study presented the remedial alternatives developed by combining the technologies identified in the previous screening process in the categories required by OSWER Directive No. 9355.0-19. Each alternative was then evaluated and screened in Chapter 9 of the Feasibility Study. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Of the twenty-one source control and six management of migration remedial alternatives screened in Chapter 9, seven source control and three management of migration alternatives were retained for detailed analysis. Table 2 identifies the source control and management of migration alternatives that were retained through the screening process, as well as those that were eliminated from further consideration.

IX. DESCRIPTION/SUMMARY OF THE DETAILED AND COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a narrative summary and brief evaluation of each alternative according to the evaluation criteria described above. A tabular assessment of each site alternative can be found in Table 12-18 of the Feasibility Study.

A. Source Control (SC) Alternatives Analyzed

Source control alternatives were developed to address hazardous substances remaining at or near the area at which they were originally located and not adequately contained to prevent migration into the environment. At the SL site, SC alternatives were developed to address contaminated material inside the quarry pits, on-site contaminated soils and subsoils and PCB-contaminated sediments.

The source control alternatives evaluated in detail for the site include a minimal no action alternative (SC-1); a containment alternative for soils (SC-2); three treatment alternatives for soils: in-situ vitrification (SC-3), solidification (SC-4), on-site incineration (SC-5); and two excavation/treatment alternatives for sediments: on-site incineration (SC-6), and solidification (SC-7). A detailed evaluation of the source control alternatives is presented in Chapter 10 of the Feasibility Study.

B. Management of Migration (MM) Alternatives Analyzed

Management of migration alternatives address contaminants that have migrated into the groundwater from the original source of contamination. At the Sullivan's Ledge Site, contaminants have migrated into the groundwater from the quarry pits in the direction of groundwater flow and within bedrock fractures. In general, the direction of off-site groundwater flow is north, toward the golf course. Contaminants have also migrated into surface water primarily from groundwater seeps and overland runoff. Chapter 11 of the Feasibility Study presents the detailed evaluation of management of migration alternatives including a minimal no action (MM-1); passive groundwater collection/treatment systems (MM-3); and an active groundwater collection/treatment system (MM-5).

C. Site Alternatives (SA) Analyzed

Table 12-1 of the Feasibility Study presents the combinations of SC alternatives with MM alternatives used in the development of site alternatives. Eight site alternatives were developed which range from no-action to treatment as a principal element for the soils, sediments, and groundwater. In developing the site alternatives, each SC alternative was subdivided into specific areas or contamination levels. For example, the site soils were divided into those that exceed the 10^{-4} present risk level, those that exceed the 10^{-5} present risk level, and those that exceed the 10^{-6} present risk level. This breakdown generates a range of soil volumes and areas that could be treated. Similarly, the PCB-contaminated sediment areas were divided into four areas: the unnamed stream, Middle Marsh, water hazards, and the Apponagansett Swamp. Site alternatives were developed by combining alternatives that would logically be used together (e.g., incineration of the soils with incineration of the sediments). In this way, a total of eight logical, feasible site alternatives were developed that address the contamination at the Sullivan's Ledge site with varying degrees of treatment and associated effectiveness, implementability, and costs. The eight site alternatives are as follows:

- SA-1 Minimal No-Action

- ° SA-2 Containment/Passive Groundwater Collection with Bedrock Trench and Treatment
- ° SA-3 Containment/Active Groundwater Collection and Treatment
- ° SA-4 Solidification of 10^{-4} Present Risk Soils, 10^{-5} Present Risk Surface Soils, Unnamed Stream Sediments, Water Hazard Sediments/Containment/Passive Groundwater Collection with Bedrock Trench and Treatment
- ° SA-5 Solidification of 10^{-5} Present Risk Soils, Unnamed Stream Sediments, Water Hazard Sediments/Containment/Active Groundwater Collection and Treatment/Passive Groundwater Collection with the Overburden Trench and Treatment
- ° SA-6 In-situ vitrification (ISV) of all Soils to 10^{-6} Present Risk Level/Solidification of all PCB-contaminated Sediments/Passive Groundwater Collection Utilizing the Bedrock Trench and Treatment
- ° SA-7 Solidification of all Soils to 10^{-6} Present Risk Level/Solidification of all PCB-contaminated Sediments in the Unnamed Stream, Middle Marsh, and Water Hazards/Containment/Active Groundwater Collection and Treatment
- ° SA-8 On-site Incineration of all Soils to 10^{-6} Present Risk Level/On-site Incineration of all PCB-Contaminated Sediments/Containment/Active Groundwater Collection and Treatment

A description of each site alternative is given below:

1. <u>SA-1</u>
<u>Minimal No Action</u>

This alternative would consist primarily of restricting access to this site. The major items associated with this alternative are as follows:

- ° perform security visits
- ° perform semi-annual site visits
- ° conduct sediment, soil, and surface water sampling to monitor contaminant concentrations and migration
- ° conduct a groundwater monitoring program quarterly for the first two years and annually thereafter
- ° conduct educational programs, including public meetings and presentations, to increase public awareness
- ° perform site review every five years
- ° establish institutional controls (i.e. deed restrictions) limiting groundwater and land use

This alternative would not be protective because it does not address public health and environmental risks due to exposure to soils, sediments and groundwater. The alternative is not permanent, is ineffective in the short- and long-term and does not attain groundwater and surface water ARARs. As with all alternatives evaluated, including the selected remedy, this alternative does not result in the attainment of maximum contaminant levels (MCLs). Additionally, this alternative does not use treatment as a principal element, and consequently, there would be no reduction in mobility, toxicity or volume of the wastes present on site. Long term monitoring and site use restrictions would be necessary. This alternative is not acceptable to the state. Finally, none of the comments received from the community support a no-action alternative.

Approximate Present Worth Cost:
$1,200,000

2. SA-2
Containment/Passive Collection

Installation of Cap; Diversion and Lining of a Portion of the Unnamed Stream; Passive Groundwater Collection; Groundwater Treatment; and Environmental Monitoring.

Alternative SA-2 is primarily a containment alternative. Under this alternative an impermeable cap would be constructed over 11 acres of the site. A portion of the unnamed stream parallel to the eastern border of the site would be temporarily diverted in order to construct a concrete channel for that segment of the stream. In addition, a passive groundwater collection system would be installed, to intercept contaminated groundwater in the overburden, shallow bedrock and groundwater seeps. The collected groundwater would be treated using a combination of chemical oxidation/filtration for metals removal and UV/ozonation for organics removal.

This alternative would achieve a short term reduction in environmental and public health risks by reducing the direct contact hazards associated with contaminated on-site soils and groundwater seeps and by reducing the potential for PCB-contaminated soils to migrate off-site via the unnamed stream. The passive groundwater collection and treatment system would reduce the toxicity, mobility and volume of groundwater contaminants in collected groundwater. This containment alternative uses readily available materials and is easy to implement.

Capping an 11-acre area of the site would partially reduce the mobility of contaminants in soil. However, the long term reliability of a cap is questionable. If the cap were to fail mobility of contaminants in soil would not be reduced. Instead, soils would migrate off-site via the unnamed steam. Long term maintenance of the cap would be required and the potential exists for future costs and potential significant public health and environmental risks if the cap were to fail.

This alternative would not reduce the toxicity or volume of soil contamination and does not utilize treatment as a principal element. This alternative does not address the full extent of the contaminated deep bedrock groundwater and therefore does not reduce the toxicity, mobility or volume of those contaminants. The contaminated sediments in the unnamed stream and water hazards would not be excavated. Therefore, this alternative also would not reduce the toxicity, mobility or volume of the sediments in the unnamed stream and water hazards.

This alternative is not supported by the state. Some members of the community favor capping to address soil contamination; others favor an active collection system instead of a passive collection system to address groundwater contamination.

Approximate Present Worth Cost:
$5,100,000

3. SA-3
Containment/Active Collection

Installation of a Cap; Diversion and Lining of a Portion of the Unnamed Stream; Active Groundwater Collection; Groundwater Treatment; and Environmental Monitoring.

This alternative is similar to Alternative SA-2 except that an active groundwater collection system consisting of bedrock extraction wells located adjacent to the pits would be implemented, instead of a passive collection system. The treatment system for the collected groundwater would be the same. The benefits and/or limitations of SA-2 are applicable for SA-3 with the exception that the active groundwater collection system, would significantly reduce the toxicity, mobility or volume of contaminants in the on-site bedrock groundwater. Therefore, this alternative does address the more highly contaminated groundwater in the deep on-site bedrock although, as in all site alternatives, this alternative does not address contamination that exists in the deep bedrock fractures off-site. This alternative is not supported by the state.

Approximate Present Worth Cost:
$5,800,000

4. SA-4

Containment/Treatment/Passive Collection

Excavation, Solidification and On-site Disposal of Contaminated Soil; Excavation, Dewatering, Solidification, and On-site Disposal of Contaminated Sediments from the Unnamed Stream and Golf Course Water Hazards; Construction of an Impermeable Cap; Diversion and Lining of a Portion of the Unnamed Stream; Passive Groundwater Collection; Groundwater Treatment; Wetlands Restoration; and Environmental Monitoring.

Under this alternative, the more highly contaminated subsurface soils will be remediated to a 10^{-4} direct contact present risk level, while surface soils will be remediated to a 10^{-5} present risk level. Excavation and solidification of contaminated soil will reduce public health and environmental risks associated with exposure to contaminated soils and will significantly minimize the potential for contaminated soils to migrate off-site via the adjacent surface waters. Construction of an impermeable cap will provide a barrier to reduce exposure to and to minimize further migration of contaminated soil. Both methodologies (solidification, capping) are easily implementable and utilize materials that are readily available. This alternative would also reduce risks posed by PCB-contaminated sediments in the unnamed stream and golf water hazards and by the contaminated groundwater seeps, overburden groundwater and a portion of the bedrock aquifer.

This alternative is not effective in reducing the long term risks associated with the deep on-site bedrock aquifer which contains the greatest concentrations of groundwater contaminants. Therefore, there will be no reduction in the toxicity, mobility or volume of contaminants in the deep bedrock aquifer. The combination of solidification of soils and sediments and capping of the site will significantly reduce mobility of contaminated soils, but will not reduce the toxicity or volume of contaminated soils.

Approximate Present Worth Cost:
$8,300,000

5. SA-5
Containment/Treatment/Active Passive Collection

Excavation, Solidification and On-site Disposal of Contaminated Soil; Excavation, Dewatering, Solidification and On-site Disposal of Contaminated Sediments from the Unnamed Stream and Golf Water Hazards; Construction of an Impermeable Cap; Diversion and Lining of a Portion of the Unnamed Stream; Passive and Active Groundwater Collection; Groundwater Treatment; Wetlands Restoration; and Environmental Monitoring.

This alternative has been chosen as the selected remedy for the site and is described in detail in Section X.

Approximate Present Worth Cost:
$10,100,000

6. SA-6
Treatment/Passive Collection

In-situ Vitrification of Soils; Solidification of Sediments; Diversion and Lining of a Portion of the Unnamed Stream; Passive Groundwater Collection; Groundwater Treatment; Wetlands Restoration; and Environmental Monitoring.

Alternative SA-6 is primarily a treatment alternative utilizing innovative technologies; in-situ vitrification (ISV) for contaminated soils and solidification for contaminated sediments. Specifically, all soils up to a 10^{-6} present risk level would be vitrified in-situ. PCB-contaminated sediments above lower value SQCs in surface waters would be excavated, solidified and disposed of on-site. Affected wetland areas would be restored to the maximum extent feasible. The passive collection system would also be installed to collect and treat the groundwater seeps, overburden groundwater and shallow bedrock groundwater.

In-situ vitrification would be effective in the long term in permanently reducing the toxicity and mobility of treated soils. Solidification would reduce the mobility of approximately 67,300 cubic yards of contaminated sediments. The passive groundwater collection and treatment system would reduce the toxicity, mobility and volume of groundwater contaminants in collected groundwater. All three treatment technologies (ISV, solidification, groundwater treatment) are considered innovative.

Contractors for the ISV technology are not readily available, and thus this alternative is not easily implementable. Furthermore, the vitrified matrix may restrict future land use of the site (i.e. soccer field). This alternative provides significant reduction of risks from exposure to contaminated soils, sediments and seeps, but does not address, to the maximum extent practicable, the deep on-site bedrock aquifer which contains the greatest concentrations of groundwater contaminants. As with SA-4, this alternative would not reduce the toxicity or volume of contaminated sediments and the toxicity, mobility or volume of contaminants in the deep bedrock aquifer. This alternative has not received state acceptance and none of the comments received during the public comment period support this approach.

Approximate Present Worth Cost:
$51,300,000

7. SA-7

<u>Containment/Treatment/Active Collection</u>

Excavation, Solidification and On-site Disposal of Contaminated Soil; Excavation, Dewatering, Solidification, and On-site Disposal of Contaminated Sediments; Construction of an Impermeable Cap; Diversion and Lining of a Portion of the Unnamed Stream; Active Groundwater Collection; Groundwater Treatment; Wetlands Restoration; and Environmental Monitoring.

This alternative is similar to SA-4 except that a much greater volume of soils (10^{-6} present risk level) and sediments would be treated and an active extraction bedrock collection system would be utilized instead of a passive collection system. Excavation and solidification of a larger volume of contaminated soil would reduce public health and environmental risks associated with exposure to contaminated soils and would significantly minimize the potential for contaminated soils to migrate off-site. Construction of an impermeable cap would provide an additional barrier against soil exposure and migration. Both methodologies (solidification, capping) are easily implementable, and utilize materials that are readily available. This alternative would further reduce risks posed by PCB-contaminated sediments and by contaminated groundwater in the on-site overburden and bedrock aquifers.

As with SA-4, this alternative would not reduce the toxicity or volume of contaminated soils and sediments. This alternative is acceptable to the state. However, no public comment was received favoring treatment of this larger volume of soils and sediments. This alternative is significantly more expensive than the selected alternative.

<u>Approximate Present Worth Cost:</u>
$18,100,000.

8. <u>SA-8</u>
<u>Containment/Treatment/Active Collection</u>

Excavation, Incineration and On-Site Disposal of Soils and Sediments; Construction of an Impermeable Cap; Diversion and Lining of a Portion of the Unnamed Stream; Active Groundwater Collection; Groundwater Treatment; Wetlands Restoration; and Environmental Monitoring.

This alternative has treatment as its principal element for site soils to 10^{-6} present risk level, sediments to lower value SQCs and the on-site bedrock aquifer. On-site incineration would reduce the mobility, toxicity and volume of contaminants in soils and sediments and the active collection/treatment groundwater system would reduce the mobility, toxicity and volume of contaminants in the on-site bedrock aquifer. This alternative utilizes a destruction technology (incineration) which is readily available. Thus, implementation of this alternative would be effective in reducing public health and environmental risks posed by contaminated soils, sediments and groundwater.

Although this alternative would result in a significant reduction of risk, SA-8 as well as all other alternatives, would not be a permanent remedy because of the untreated wastes contained within the pits which will continue to act as a contaminant source. Long-term monitoring and maintenance would still be required. Finally, high lead soil concentrations (maximum 4650 ppm) may result in exceedance of ambient air levels due to excessive lead emissions emitted during incineration.

Approximate Present Worth Cost:
$88,000,000.

X. THE SELECTED REMEDY

The selected remedial action consists of source control and management of migration components listed in Section VII but excludes action on Middle Marsh which will be addressed as an operable unit. A comprehensive approach is necessary in order to achieve the response objectives established for site remediation and the governing legal requirements.

A. Description of the Selected Remedy

After evaluating all of the feasible alternatives, EPA is selecting a nine-component plan to address soil, sediment and groundwater contamination at the SL site:

1. Site Preparation

The site preparation work includes the establishment of security and controlled access to the site, the connection of light and power utilities and the furnishing of sanitary facilities. A chain link fence will be constructed around the perimeter of the site and designated off-site areas expected to include the groundwater treatment facility, areas of excavation, and additional areas defined during remedy design. To the maximum extent feasible, the existing fence will be utilized. Warning signs will be posted at 100 foot intervals along all fences and at the entrance gate.

Areas to be remediated will initially be cleared of vegetation and debris. Most of these materials will be re-disposed of on-site. Cobblestones that will be disposed of off-site will be sampled for residual contamination. If PCBs are detected, the debris will be decontaminated, upon evaluation of the cost effectiveness by the EPA, with an approved physical removal process (i.e. scrub/wash/steam-clean or sand blast/steam-clean). After areas have been cleared, grading will be performed to provide areas for remedial operations, staging and to promote controlled site drainage.

Runoff controls will be developed in accordance with the conceptual design presented in Figure 5, and as discussed in Section 10 of the FS. Components will include drainage ditches on the western and southern site boundaries, a new sedimentation basin and dikes constructed adjacent to the eastern and northern boundaries of the site's disposal area. Erosion and sediment control measures used during the construction period are also considered part of the site preparation work.

2. **Soil Excavation/Treatment**

This component is composed of the following: excavation, grading, solidification, on-site disposal, backfilling, predesign work and implementation monitoring. A processing area will be set up at the site prior to soil excavation. All on-site unsaturated soils contaminated above the soil cleanup levels described in Section X.B.1.a., including soils within the 100-year floodplain, will be excavated (see Figure 6-4 RI). Off-site soils contaminated above target levels described in Section X.B.1.b. will be excavated from areas shown in Figure 6. Bulk debris will then be screened out of the excavated materials. Screened-out debris will be disposed of on-site. All debris disposed of on-site will be contained within waste cells formed out of compacted solidified product or within excavated areas and ultimately covered. All excavated soils contaminated above 50 ppm of PCBs and/or 30 ppm of PAHs will be placed, along with a hardening agent, in a mixing unit for solidification. The solidified material will then be disposed of on-site beneath the proposed landfill cap, above the existing ground surface and outside the 100-year floodplain. Coordination between the implementation of the solidification processes and cap construction will be necessary to avoid extended exposure of solidified material. Excavated areas on-site within the boundaries of the cap may be backfilled with clean fill, excavated off-site soils containing between 10 and 50 ppm of PCBs and/or debris generated during site preparation and excavation. For excavated areas beyond the boundaries of the landfill cap, final restoration will consist of backfilling with clean fill, grading, loaming and seeding.

Unsaturated soils with contaminants above the cleanup levels, as defined in Section X.B.1., will be excavated. On-site, the volume and area of soil to be excavated is shown in Figure 6-4 of the Phase II RI, and is estimated at 24,200 cubic yards. The volume to be excavated off-site will be defined by predesign sampling. The unsaturated zone at the site is defined as that area from the surface elevation to the seasonal low groundwater table.

Predesign work includes off-site sampling, defining the unsaturated zone and solidification treatability studies. Off-site areas to be sampled are shown in Figure 6 and described below:

1. East of the existing fence along the eastern boundary of the site, from the southern boundary of the site to the Hathaway Road culverts. This area includes the east and west banks of the portion of the unnamed stream along the eastern border of the site.
2. Just north of Hathaway Road and south of the intermittent tributary to the unnamed stream within the golf course.

The sampling program will determine the nature and extent of PCB contamination in surface and subsurface soils in the unsaturated layer in the above referenced areas. Based on the sampling data, areas with soil contaminants in excess of 10 ppm of PCBs and of 50 ppm of PCBs will be defined. The seasonal low groundwater elevation will be defined by implementing a monitoring program that will evaluate the fluctuation of the water table. This program will monitor the fluctuation for all four seasons, but with particular focus on the summer months. Bench-scale testing of the solidification process using representative soil and sediment samples will be performed to evaluate solidifying agents and mixtures. EPA is specifically requesting that treatability tests include the mixing of lime with soils. Testing to determine appropriate and optimal use of hardening agents will consist of leachability tests. EP toxicity tests will also be performed to determine whether certain soils will be RCRA - characteristic waste after solidification.

An air monitoring program will be implemented during the performance of the on-site and off-site soil excavation and treatment component of the remedy to determine risks to on-site workers and nearby residents. Air sampling stations will be located at representative points throughout the site and at the perimeter of the site. Samples will be analyzed, at a minimum, for VOCs, PCB in vapor phase and PCB particulates. To limit potential air emissions the following methods may be implemented: enclosure of the work areas; emission suppression techniques (ie. foam, water spray); and containment of excavated soils.

EPA anticipates that some amount of off-site wetlands areas will be impacted by soil excavation. For those areas, steps will be taken as described in component 7, to minimize potential destruction or loss of wetlands or adverse impacts to organisms.

Upon completion of the excavation of on-site and off-site soils, samples will be collected and evaluated against the cleanup levels for soils (see Section X.B.1). These samples will be used to evaluate the success of excavation.

3. **Sediment Treatment**

The sediment component is composed of: preparation work, excavation/dredging, dewatering, transportation, solidification and disposal. Initial preparation work will include construction of roadways and, where needed, clearing of trees and shrubs. Cleared materials will be disposed of on-site. Initially, sediments from the designated areas shown in Figure 6 will be excavated to a depth of one foot. Dewatering of excavated sediments will be performed (i.e. filter presses) to reduce sediment moisture content. Effluent from the dewatering operation will be treated to comply with state water quality standards, as discussed in Section X.B.3.c. Presently, the EPA expects that activated carbon or the on-site treatment plant will be used to comply with these standards. Treated effluent will be discharged to the unnamed stream. After the dewatering process, the dewatered sediments will be solidified and disposed of on-site above the existing groundwater surface, as described in the preceding section.

An estimated 1,900 cubic yards of sediments in excess of the sediment cleanup levels, as described in Section X.B.2., will be excavated or dredged and transported to the site's landfill area. Areas to be excavated are shown in Figure 6 and described below:

a. Unnamed stream and tributaries from areas south, east and north of the site to the golf course water hazards
b. The first water hazard north of the unnamed stream and a portion of the next water hazard.

EPA shall determine when excavation activities will be performed upon evaluating weather conditions, stream flow, scheduling constraints, and the impacts of construction activities on the golf course. Excavated areas will be isolated by means of erosion and sedimentation control devices (i.e. sedimentation basin) and diversion structures to limit the resuspension of contaminated sediments. Methods such as sedimentation basins and/or silt curtains will also minimize the amount of contaminated sediments moving downstream during dredging. During excavation of PCB-contaminated sediments, downstream monitoring of surface water will be conducted to ensure that transport is not occurring as a result of the excavation.

An air monitoring program will be performed during the implementation of this component to monitor risks to on-site workers and nearby residents, as described in the soil treatment component of the remedy. Mitigative measures, such as those discussed in the preceding section, shall be taken during excavation, transport and treatment to control emissions.

For wetlands areas affected by sediment excavation, steps will be taken as described in component 7, to minimize potential destruction or loss of wetlands or adverse impacts to organisms.

After the initial excavation of sediments, sediment sampling of the excavated areas will be performed to ensure compliance with the sediment target level. Sediment samples will be analyzed for PCBs and TOC. These samples will be used to evaluate the success of excavation/dredging. Based on the sampling results as well as field judgement, additional excavation at one foot depth intervals shall be performed in any area where sediment contaminant levels are equal to or greater than the sediment target level.

4. **Construction of an Impermeable Cap**

The purposes of the impermeable cap are to reduce human and animal exposure to the solidified soils and sediments, to reduce exposure to untreated contaminated soils and wastes within the pits, and to reduce the amount of precipitation that could filter through the waste and carry contaminants into the groundwater and away from the capped area.

This component is composed of the following: grading, backfilling, capping, predesign work and implementation requirements.

As described under the site preparation component, the first step in constructing the cap will be to remove the trees and brush from the site's surface area. Excavated areas will be backfilled and the site regraded prior to on-site disposal of the solidified soils and sediments. The layers of the cap will then be constructed on top of the solidified soil and sediment layer.

The detailed design of the cap will be finalized during the design phase of the remedy to meet the performance standards set forth in the Massachusetts Hazardous Waste Regulations, including the requirement that the clay layer have an average permeability of 10^{-7} cm/sec. Based on the conceptual design described in Section 10 of the Feasibility Study, the cap will consist of four layers (see Figure 7). The base of the cap will consist of a two-foot clay layer of an average permeability of 10^{-7} cm/sec. To protect the clay layer from the effects of frost, an 18-inch buffer layer of soil will be installed above the clay layer. A permeable drainage layer, consisting of 12 inches of sandy soil will then be placed above the buffer layer. Water that passes through the upper layers of the cap will drain off to the sides of the cap, over the buffer and clay layers. This water will be collected in drains around the edge of the cap, and discharged to the unnamed stream. Above the drainage layer, a 2-foot vegetative layer will be installed consisting of 18 inches of sandy soil and 6 inches of topsoil. Grass will be planted in the topsoil.

The cap will be constructed over a projected 11-acre area extending over the total surface area of the site with the exception of the area within the 100-year flood plain (see Figure 8). As discussed under the second and third components of the selected remedy, the cap will be constructed over the contaminated surface soils and sediments that will be solidified and placed on-site. The cap will also cover unsolidified soils within the 11-acre area that may contain contaminants below the cleanup target level.

Predesign studies will consist of permeability testing of clay mixtures to determine the optimal clay mixture for compliance with the design requirements of a 10^{-7} cm/sec permeability. Both lab and field patch tests will be performed to check compliance with requirements.

Implementation requirements will include erosion and sediment control measures, as discussed in component 1 (site preparation) of the selected remedy. Erosion which may occur during the vegetation establishment will be controlled by applying hay bales or erosion control fabrics. Site regrading of the northeastern corner of the site, within the 100-year flood plain of the unnamed stream, will be limited

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